

Establishment of an Eastern
Visibility Fine Particle Network

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A comprehensive assessment of eastern regional haze is being undertaken by EPA's Environmental Monitoring Systems Laboratory. An Eastern Visibility Fine Particle Network (EVFPN) is being set up to study the relationships between fine particles and visibility. A long-term data base will be established to aid in determining spatial and temporal variations in indicators of visibility degradation in the Eastern United States. A further refinement of the visibility/particulate components relationships, with emphasis given to the nonsulfate components such as carbon and nitrate, will be developed. The monitoring strategy used to obtain optical properties, aerosol characteristics, and the characteristics of a scene will be discussed along with the general overview of the Eastern Visibility Fine Particle Network.

KEYWORDS: *Haze, *EVFPN(Eastern Visibility Fine Particle Network).

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EASTERN VISIBILITY FINE PARTICLE NETWORK

INTRODUCTION

As a result of an EPA task force established in 1984 to examine long-term strategies¹ for visibility impairment from pollution derived regional haze, the Environmental Monitoring Systems Laboratory (EMSL) at RTP was given the responsibility of establishing and operating a research oriented visibility-fine particle network in the Eastern U.S.

The overall purpose of the network is to facilitate the review of the particulate matter air quality standards with respect to fine particles and visibility. Specifically it is planned that EMSL will establish a visibility-fine particle monitoring network to develop a long-term data base for the Eastern U.S. for the following purposes:

1. Determining the spatial and temporal variations in the indicators of visibility degradation in the Eastern U.S. (FP mass, sulfate, and light extinction from scattering) focusing on regional concentrations and natural background, with limited attention to urban areas.
2. Refining visibility/particulate component relationship, especially for nonsulfate components (e.g., carbon, water, selected organics, and nitrate at selected sites).
3. Developing a data base for receptor modeling to determine the prevailing causes of visibility degradation and elevated fine particle concentrations by source and by chemical composition. Also, for assisting in the evaluation of regional fine particle and visibility dispersion models.
4. Providing a data base to elucidate links between visibility impairment, climatic effects, and acid deposition caused by anthropogenic air pollutants.

The Eastern Visibility Fine Particle Monitoring Network (EVFPN) was initiated with sampling protocol in January 1986. Due to the type of funding, the entire operation will be conducted by a contractor under the direction of EMSL at RTP.

Concurrently, a Western Visibility Network, sponsored by EMSL at Las Vegas, was initiated to address visibility regulations in Class I areas. The Western network which covers three National Parks in the east was designed to study visibility under a different set of conditions. There are long distance vistas in the West while the East has shorter distance views, and the distributions of components and haze are considerably different between east and west, and the magnitude of the fine particle component is considerably greater in the east.

Approach

With limited resources available for equipment purchase and operation, it was decided that the Eastern Visibility project would have to collaborate

with other long-term networks collecting supporting data which could also apply to visibility data. Two such networks are in their early stages: the Dry Deposition Network (DDN) and the Southern Commercial Forest Ozone Network (SoComON). Figure 1 depicts the proposed eastern sites.

There are three types of information that have been determined to be needed for the Eastern Visibility Program: (1) The characteristics of a scene viewed at a distance must be monitored to document the scene-specific visibility, (2) the optical properties of the atmosphere must be monitored for a scene-independent measure of air quality, and (3) the aerosol characteristics must be determined to associate atmospheric optical properties with responsible pollutants. In addition, supplemental data including meteorology and continuous gaseous data are important for interpreting the results.

There will be two types of sites for the visibility study - Tier 1 and Tier 2. Tier 1 sites are primarily nonurban and will be the core research sites located with the DDN or SoComON networks. These sites will include an automated fine particle sampler for integrated filter samples, a nephelometer, for B_{scat}, and an automated camera for vista recording and collection of meteorological parameters including wind speed, wind direction, temperature, dewpoint, relative humidity, and solar radiation. It would be helpful to have ozone, sulfur dioxide, and nitrogen dioxide if available from other network operations. The Tier 2 sites will be camera-only sites and are proposed to be located where PM-10 monitors are presently operated at State and Local Agencies' Monitoring Sites (SLAMS).

The siting criteria for Tier I type sites is essentially the same as DDN with a few additional requirements. The following are basic factors:

- Site stability.
- Site accessibility.
- Site utility requirements.
- Immediate surroundings.
- Regional character.
- More than one vista with a camera target at least 10 kilometers away.

The EVFPN was originally planned to be compatible to the Western network and to provide, where possible, the purchase of identical equipment. As the two networks have evolved, only the camera system could be the same because the sampling scenarios are considerably different.

Equipment

The equipment to be used is listed in Table 1.

For the aerosol sampling, a modified Andersen Model 245TD automatic dichotomous instrument was chosen for unattended daily sampling for particles <2.5 μm . Since light scattering is due to fine particles, two 2.5 μm cyclone inlets operating at 23 l/mn are utilized to obtain carbon data on a 37 mm quartz filter and sulfate and trace elements on a 37mm 2 μm porosity Teflon filter. The nephelometer provides an estimate on the light scattering coefficient (B_{scat}) and visual range, while the camera provides both a visual range estimate and documentation of the view.

Table I. Tier 1 and Tier 2 equipment.

<u>Site</u>	<u>Network</u>	<u>Instrument</u>	<u>Parameter</u>	<u>Analyses</u>
Tier 1	EVFPN	Automated fine particle sampler w/2 filters:		
		Teflon	FP Mass	Elements by XRF, Sulfate, Nitrate babs by light attenuation
		Quartz	(for analyses only)	Carbon (total and organic and elemental)
		Nephelometer	Light scattering	
		Camera	Visual range	Interpretation of density of photographic slide
	DDMP	DDMP meteorology	Hourly: surface wind direction, surfact windspeed, surface wetness, temperature, relative humidity, solar radiation, precipitation	
		Filter pak	Weekly: SO ₂ nitrate, nitric acid	Weekly: SO ₂ , nitrate, nitric acid
		Ozone	Ozone	
Tier 2	EVFPN	Camera	Visual Range	
	SLAMS	24-hr PM ₁₀ and possibly FP Mass (daily or less frequent)	PM ₁₀ and possibly FP mass	None planned

METHOD DEVELOPMENT AND FIELD EVALUATION

Since the modified Andersen model 245TD had been used only as a prototype, two activities were undertaken to test the unattended operation capability and validate the sampler. The first was to participate in the California Air Resource Board (CARB) Carbon Study comparing different carbon samplers and laboratory analyses. The 10-day intensive study took place in the latter part of August and the results are not yet available. Preliminary results indicate good precision between instruments.

The second activity started in December at the DDN White Face Mountain site which at present is the only DDN site suitable for visibility siting requirements. This pilot test studied the unattended operation of the 245TD while collecting two 12-hour samples daily for a one-month period. The samples were collected by the operator on a weekly basis as it will be in the routine network. A nephelometer and a camera unit were also field tested. This one-month field test did point out a few problems that might occur in the routine network. One particular problem found was the aerosol sampler froze during sub-zero weather. A heating mat corrects this problem.

Work is in progress on a cheaper method to analyze the sample for total, organic, and elemental carbon. The method under test uses Fourier transform infrared transmission spectrometry (FTIR), and is being examined at the Lawrence Berkeley Laboratories. If this method is successful, it will reduce the carbon analysis cost by more than 50%. Carbon has been found² to be second only to sulfate as a component in the fine fraction in several studies in the East. It plays a contributing role in both light scattering and light absorption in addition to providing a form of tracer for receptor modeling.

Network Deployment

Tier 1 site deployment is dependent on the DDN siting schedule. The DDN contractor is expected to have an additional six sites on-line by June 1987 and up to 30 sites by September 1987. Siting data, including vistas from DDN, have been reviewed³ for the northeast, and four sites are prime sites meeting the visibility siting requirements. They are Beltsville Farm, Maryland; Horten Station, Virginia; Perryville, Kentucky; and Argonne National Laboratories in Illinois. The locations are indicated in Figure 1.

SUMMARY

The development of the EVFPN during the first year has been slower than anticipated. Reductions in funding have made the EVFPN more dependent than expected on the development and deployment of other networks. These delays can be viewed as beneficial to the EVFPN network. It has provided the opportunity to further test and evaluate the equipment in the Carbon Study and the field evaluation. The results of the CARB Carbon Study will provide insights on comparison of both the collection techniques and the analysis techniques of ten different samplers and their associated methods of analysis. The results will also provide precision and accuracy measurements of the EVFPN carbon measurements. The December 1986 field evaluation at the DDN White Face Mountain site uncovered a few sampling problems associated with low ambient temperatures.

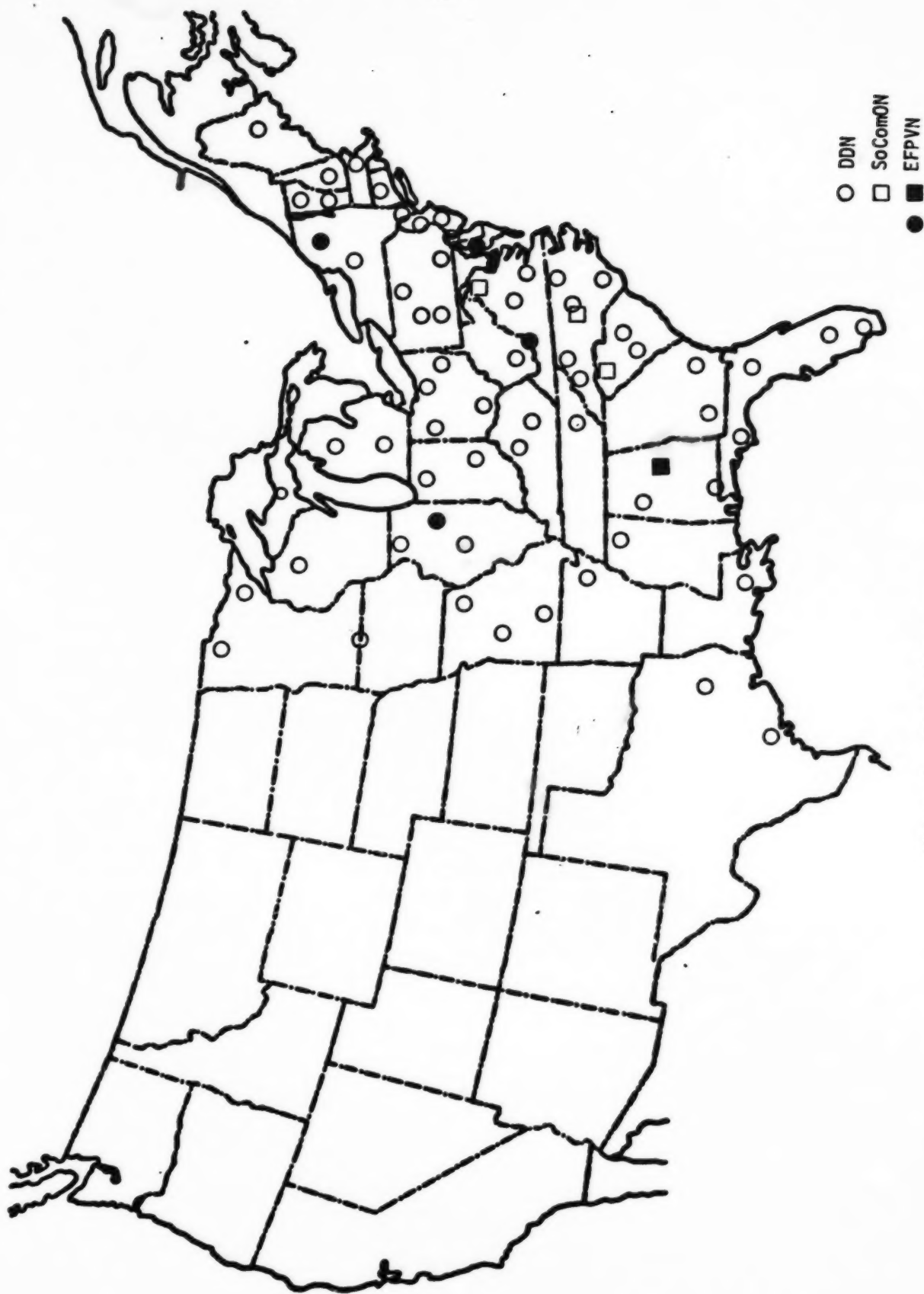


Figure 1. Potential Sites

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